MESOPOTAMIAN SONIC PROTO-THEORY

*Richard Dumbrill**

INTRODUCTION

In this essay, it is contended that music theory is the consequence of numeracy and literacy, both developed by the Urukean society during the fourth millennium B.C. along with five other seminal inventions. Prior to the writing revolution, our postulation is that sonic expression, intrinsic and therefore as old as mankind, was one of many unconscious phenomena. While it is impossible to define, with certainty, what was its nature, it is indubitable that it was alien to any form of geometrical/arithmetical constructions such as diatonism, heptatonism, pentatonism, etc., for the aforementioned premise that these arose as a consequence of writing. Our study of ethnomusicology, from rare locations where music remains unspoilt from Western acculturation, shows that sonic expression also came from the unconscious as it remains devoid of any conscious pollution.

CBS 10996

In 1960, a then young student of Assyriology, Anne Draffkorn-Kilmer, published a cuneiform text written on a clay tablet[1] listing numbers followed or preceded by the names of strings, of an undefined musical instrument[2]. Nevertheless, she entitled her article "Two New Lists of Key Numbers for Mathematical Operations". The article was part of a Festschrift published on the occasion of Professor Benno Landsberger's 70th birthday.

At the time she wrote her article, Kilmer was hesitant in defining the text as being strictly "mathematical[3]". She erroneously dated the text from the Kassite Period[4], about 1500 B.C. However, it has since been re-dated, and all agree that it is from the Neo-Babylonian Period, early first millennium B.C.

Now, Kilmer's hesitation came from her intuition that the numbers preceding or following the musical terms might establish a relationship between them[5].

It is highly surprising that Anne Kilmer, student of a prestigious American University did not immediately perceive that the numbers in the text displayed a broken pattern, but then she was neither mathematician, nor musicologist. The paired numbers is given below without the names of "musical[6]" terms with which they are

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[1] [Kilmer, 1960].

[2] The identification of the text as being about music was based on the Sumerogramme SA: Pitnu B, substantive; the string/note of a musical instrument Sa-a SA = *ši-ir-a-nu, gi-du, pi-it-nu* Ea IV 71 (J.A. Knudtzon, Die El-Amarna Tafeln (=VAB 2); EA 359-79: Rainey EA); sa *pi-it-nu-um* Nigga 291 (Nigga lexical series nigga = *makkuru,* published by Civil, MSL 13 91-124); sa = *[pi]-i[t]-nu-um* Nigga Bil. B 243; [sa].a = MIN (= *pi-it-nu) šá* ZÀ.MÍ (for context see *pitnu* A lex. Section in The *Chicago Assyrian Dictionary*) Antagal (Lexical series antagal = šáqû, published by M.T. Roth, MSL 17) A 155; *[pi]-it-nu, [ta-p]a-lu, [x-x]-x-lu,* →

→ *[i]-nu* (Sumerian column broken) Antagal D 178 ff. [l]a-gab LAGAB = *pi-it-n[u] še-[la-áš-ti]* Hh. (Lexical series HAR.ra = *hubullu* ((Hh. I-IV published by Landsberger, MSL 6; Hh VIII-XII, XIX published by Landsberger, MSL 9; Hh. XVI-XVII published by Landsberger and Reiner, MSL 10; Hh. XX-XXIV published by Landsberger and Reiner, MSL 11) VII B Gap a line b, cf. Hg. B II 171, in MSL (Materialiem zum sumerischen Lexikon) 6 124 and 142; [9].sa.a = 9 *pi-it-nu* Nabnitu (:Lexical series SIG_7 + ALAM = *nabnitu,* published by Finkel, MSL 16) XXXII i 10. gù.téš.a.ra.ra = MIN *(ra-ga-mu) šá pit-[nu],* gù.téš. de = MIN <*šá*> *tim-bu-ut-ti* to make a sound said of *pitnu,* ditto said of the harp Nabnitu B 199f.; [(x)].gur_5 = MIN (= *šá-ba-tu) šá pit-nim* Nabnitu XXIII 61.

[3] CBS 10996, (Catalogue of Babylonian Section, University Museum of Philadelphia).

[4] The Kassites were an ancient Near Eastern people who controlled Babylonian after the fall of the Old Babylonian *ca.* 1531 B.C. until *ca.* 1155 B.C. The Kassites gained control of Babylonia after the Hittite sack of the city in 1595 B.C. and established a dynasty based in Dur-Kurigalzu. They were were members of a small military aristocracy, efficient rulers though not locally unpopular. Their 500-year reign laid an essential groundwork for the development of subsequent Babylonian culture – see [Wikipedia Contributors, 2014b].

[5] There, she was right, enlightened by a communication from Professor Gurney, of the University of Oxford, who informed her of a then unpublished Old-Babylonian tablet, about 1800-1750 B.C., excavated at Ur by Sir Leonard Woolley in the late 1920s, field Number (U.3011) better known as *nabnitu* XXXII, the thirty-second part of a large lexical text which was finally published by Gurney in 1973 and renamed UET VII 126 (seventh volume, tablet number 126, of the Ur Excavation Texts). The tablet was sent back to the Iraqi Museum in Baghdad and we do not know if it has been destroyed, damaged or stolen during the coalition invasion. In the past years, I was unable to gain access to the museum.

[6] I am getting increasingly reluctant with the usage of the terms "music", "musical" and other derivatives insofar as the etymology sprouts from the nine muses of Ancient Greek mythology and that none of these creatures was ever, in any narrative, involved with "music". The Muses were only transmitting what the gods of the pantheon ordered them to mortal artists, musicians among them.

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labelled, as they are irrelevant for our present purpose: 1-5; 7-5; 2-6; 1-6; 3-7; 2-7; 4-1; 1-3; 5-2; 2-4; 6-3; 3-5; 7-4; 4-6.

In a recent communication, Nick Stylianou suggested that these pairs might have indicated simultaneous rather than consecutive pairs. However we must remember that instruments and musical theory are different extensions of the primeval human instrument which is the voice. Since the voice cannot sing two notes simultaneously, we shall assume that numbers were consecutive. This understanding is supported by the epigraphy which, in the text under scrutiny, also suggests consecutiveness as pairs do not always have the same polarity (ascending or descending) implying that one number always followed the other and were not superimposed. Additionally, the scribe wrote his numbers in the following pattern, for example:

SA *qud-mu-ú ù* SA *4 uḫ-ri...* (string front and string 4 of the behind), which schematically is: "string x 'and'(*ù* in Babylonian) string y", with the conjunction *"ù = and"*.

He could have written, for example, "string x 'with'(*itti* in Babylonian) string y", with the preposition *"itti = with"* thus distinguishing consecutiveness from simultaneity.

In graphic form the numbers translate as:

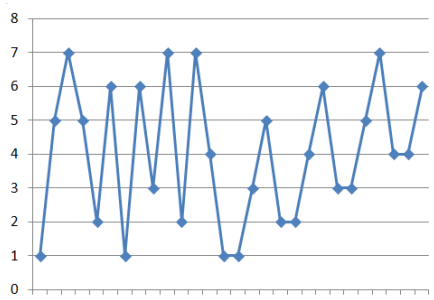

Fig. 1 Graphic representation of CBS 10996.

This is a broken sequence restricted to a span of 7 numbers. Should the sequence be extrapolated to a logical order then we would have the following sequence:

1-5; 7-5; 2-6; 8-6; 3-7; 9-7; 4-8; 10-8; 5-9; 11-9; 6-10; 12-10; 7-11; 13-11.

Which in graphic form gives:

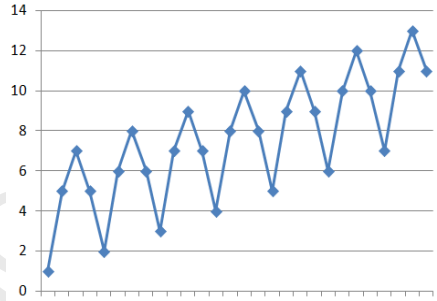

Fig. 2 Graphic representation of CBS 10996, in its hypothetical original extrapolated 13 number span arrangement.

This graphic shows that the sequence in the text, which would have originally comprised a span of 13 numbers, was later compressed into a span of 7 numbers for reasons which will be later explained.

Readers will note that I have purposely avoided the common usage of the term "tone[7]" for the reason that it might imply it was Pythagorean (tone of 9:8 = 204 cents) or of an equal temperament setting (tone of 200 cents), or of any other value.

Our text only mentions numbers of undefined quantities with no evidence of the measurement of the intervals between them and that furthermore, the notion of a "semitone" placed in the series, to satisfy an "heptatonic" hypothesis, is also avoided for the sake of objectivity. The pattern given in the text could as well evoke either an isosonic[8] series in which all intervals are approximately equal, or it might evoke an heterosonic series including approximately half-split intervals, or other arrangements.

During the following years, writers who wrote about this text: Duchesne-Guillemin[9]; Wulstan[10]; Crocker[11], Kümmel[12], and others, all agreed, despite the lack of evidence, that the Babylonian musical system was a), ascending, b) diatonic, c) heptatonic and d) included intervals of fifths, fourths, thirds and sixths, all Pythagorean[13] and e) that the whole was inscribed within an octave. As a consequence, the world-famous *New Grove* still publishes this fallacy, preposterously but hopefully not perpetually. Needless to say that such postulations are rigorously flawed for the following reasons:

- There was no reason to assume that the system was ascending or descending:

[7] The Greek τόνος means I) stretched sinew, or being able to be stretched, particularly of 1) [a] string, a rope or a cable. 2) Bed strap. 3) Ropes, specifically of a mechanical apparatus such as a mechanical bow. 4) Fishing het twisted string. 5) Muscle or tendon and the action of stretching both. 6) Tension of the strings of a lyre. Then only, the word is associated with what some musicologists call "modes" such as the Dorian Lydian and phrygian, only. But it is also the rhyme of a verse of six measures or hexameter. Therefore the usage of "tone", of "tonality", of "tonic", etc. is flawed – [Bailly, 1895].

[8] "Sonic" means "of or pertaining to sound or sound waves". This term, devoid of all mythology is strictly scientific and therefore "sound" will replace "tone" unless "tone" refers to a particular measure such as the "Pythagorean", etc.

[9] [Duchesne-Guillemin, 1966].

[10] [Wulstan, 1968].

[11] [Crocker and Kilmer, 1984].

[12] [Kümmel, 1970].

[13] With the exception of Crickmore and Hagel who finally understood that Babylonian metrology would have been the favoured arithmetical method, rather than the Greek Pythagorean.

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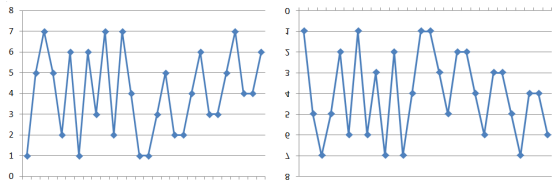

Fig. 3 Graphic representation of CBS 10996 in ascending form, left and descending form, right, in its reduction to a span of 7.

or:

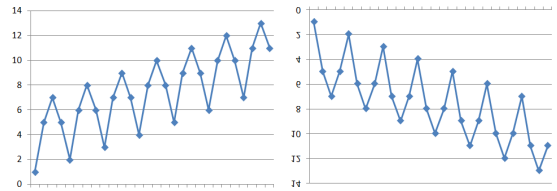

Fig. 4 Graphic representation of CBS 10996 in ascending form, left and descending form, right, in its expansion to a span of 13.

- There is no reason whatsoever to assume, that at that time, the system was "diatonic", "heptatonic", "octavial" and "Pythagorean", since the nature of the intervals were not quantifiable. Had it been "diatonic" then what would have been the nature of its "diatonism", especially in the light that the term itself does not mean what Western theoretician generally believe it does. Indeed, Merriam-Webster says: "of, or relating to a musical scale which has five whole steps, and two semitones". However, this is a meaning of convention which does not reflect the original late Latin, *diatonicus,* from Greek *diatonos*, "stretching", from *disteinein,* "to stretch out", from *dia* + *teinein*, "to stretch". It is worth noting that the English term "diatonic" was first used only in 1694[14].

Therefore the assumptions of my colleagues were probably the consequence of either their "Hellenistic subjectivism[15]", or even in some cases, of some remnants of "Occidental imperialism", or simply of their ignorance of other systems differing from the Pythagorean paradigm. I have even heard, in a private communication, a learned colleague of mine saying that he would not be surprised if our unconscious cognition had "Pythagorean heptatonic diatonism" embedded within.

None understood, or wanted to agree, that the compression into a span of 7 was the consequence of the advent of a form of "heptatonism"[16] which took place, I contend, in Babylon, and not in Greece, during the first millennium B.C. Ratios of 4/3 ("fourth"[17]) and 8/5 ("sixth") were added to ratios of 3/2 ("fifth"), 5/4 ("major third") and 6/5 ("minor third")[18], as a consequence of their inversion during the process of compression. Obviously these intervals would lead to the ratio of 2/1 ("octave")[19]. However, this interval which is subjectively called "octave" as it only applies to certain systems of eight pitches, the first or the last being double or half the frequency of the first, or of the last one. But the presence of this interval, which is only implied, and for which we have no name in the Ancient Near East, does not prove that its concept was understood. "Octavial interval" and "octavial concept" are two distinct things having distinct meanings. As an interval, the "octave", conventionally includes a series of 8 degrees while the "concept" establishes a supposedly universal rule by which all serial or other systems can only be contained and analysed within its boundaries; it is used as "pitch sampling" the limitations of which being obvious as there are no reasons why certain exogenous systems must be contained within one "octave". Its usage is mainly metonymic, at least in Judeo-Christian societies as it associates "musical heptatonism" with the seven days of

[14] Diatonic (adj.) c. 1600, from French *diatonique*, from Latin *diatonicus*, from Greek *diatonos* "extending; pertaining to the diatonic scale," from *dia-* + *tenein* "to stretch" (see [Anon. "Online Etymology Dictionary"]). The Oxford English Dictionary has: "Holder [writing in] 1694 [his] *Treatise of Harmony*, published in 1730: 'The diatonick had two Colours'; it was Molle and Syntonum" – [Simpson and Weiner, 1989, "Diatonic"].

[15] And from what some believe to be Greek paradigms, relying only on mediaeval scribal infallibility in their copies of original Greek texts which vanished as soon as they were "transcribed" in monasteries of Christendom, after the Crusades.

[16] As explicitly described in cuneiform text CBS 1766. See Dumbrill, R., "The earliest evidence of heptatonism in a late Old Babylonian text: CBS 1766," in https://www.academia.edu/243915/Earliest_Evidence_of_Heptatonism : this article is unpublished as it stands but was published under two different titles: 1) "Four Tables from the Temple Library of Nippur: A Source for Plato's Number in Relation to the quantification of Babylonian Tone Numbers", [Dumbrill, 2009a, p. 27–38], and "Is the Heptagram in CBS 1766 a Dial", [Dumbrill, 2009b].

[17] The conventional terms "seconds"; "thirds"; "fourths"; "fifths", etc., qualify "empty" intervals. For intervals which contain consecutive degrees, henceforth, I shall use the terms "pentad" to mean "a group of five consecutive pitches, of an undefined value and which therefore amount to a span larger, or smaller than the conventional 'just' fifth." This applies to all other following denominations, exception made, obviously for the "unison", hence the terms "unison", one pitch; "dyad", a series of two pitches; "triad", a series of three consecutive pitches; "tetrad", a series of four consecutive pitches; "pentad", a series of five consecutive pitches; "hexad", a series of six consecutive pitches; "heptad", a series of seven consecutive pitches; "octad", a series of eight consecutive pitches; "ennead", a series of nine consecutive pitches, etc.

[18] In fact, these ratios are irrelevant since I contend that before numeracy, (and probably a long time after as ethnomusicology proves) thirds were all neutral and might have been anything around 11/9; 27/22 or 16/13.

[19] While the names of conventional intervals infer that they are empty, the term "octave" means both "interval" (empty), and "concept" (container of a system, such as "pentatonic", or "heptatonic".

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Genesis, the Sabbath day, with the menorah, the seven plagues of Egypt, the Seven Feasts of the Lord, Newton's mystic seven colours and all things seven, generally[20].

The "octavial concept" was first formulated by Juan Caramuel[21] in 1647 A.D., and with it the "return to the tonic" principle, a consequence of the concept. Therefore it is preposterous to mention that an "octavial concept" existed prior to the 17th century A.D., since it depended on the first "musical" logarithms, invented by Napier around 1620, followed by Juan Caramuel, 1647[22]; Jean Sauveur's division of the octave in 301 *eptamerids* in 1701; Prony with 12 *pronys* per octave, at the end of the 18th century; Savart with his division in 301.03 *savarts* in 1820 and finally Ellis, in 1875, with the division of the same in 1200 *cents*. Once the octave equally divided (equal temperament by means of logarithms), the only "just" interval remaining was the octave. This is how and why it became the concept or the unit it is. Musical compositions issuing from it found the urge, by the process of attraction, to "return to the tonic" which otherwise would not have been necessary.

Whenever we read about "octaves" in Arabian, Farsi, Turkish, and other non Occidental manuscripts, it is the interval which is meant and not the concept. However, the distinction is arduous for some because of Occidental "hangovers".

To conclude with this first text, there are two types of intervals listed: series of 5 pitches and series of 3 pitches. While it would be possible to assume that sets of 5 would imply the span of just fifths, and that sets of 3 would be spans of thirds. However, which form of third would they be: minor or major? Since there is no distinction given, we can only assume that they would be approximately neutral, in keeping with the isosonic[23] (approximate) proposition which is partially perpetrated in contemporaneous Arabian music.

NABNITU XXXII

Another text, aforementioned, (U.3011 [field number]) = *nabnitu* XXXII = UET VII 126 was not at all understood by any of my colleagues, with the exception of Crickmore to whom I explained the principle in a conversation during lunch at the School of tropical medicine in London some years ago.

I contend that this text was the copy of a much older tablet the contents of which having been emendated during the Neo-Babylonian Period. On grounds of a logical theory chronology, I would postulate that the original document from which the present tablet would have been copied might have been Old-Babylonian. This is mostly because the musical terms given within were already known from an Old-Babylonian Period tablet[24]. Additionally some of the case endings have mimations[25], which is typical of the Old-Babylonian linguistic period although these may also happen later either because of scribal accuracy in copying earlier originals and for other reasons which shall not be discussed in the present paper.

All thought that the text gave a straightforward enumeration of the nine strings of an instrument within which a "heptatonic" system was hosted.

The tablet is the palindromic/epicentric enumeration of a set of nine pitches. All argued that despite of the evidence of nine pitches, which are consistently present in the few texts of music theory which have reached us, such as UET VII 74[26], and YBC 11381[27], and that this set is even perpetrated in Plato's Muses[28], that the Babylonians meant that it was, extraordinarily, a "heptatonic" system which was intended.

The text is unambiguous. It gives the following series of nine numbers: 1-2-3-4-5-4-3-2-1. The first "1" is said to be the "first front string" and the last "1" is said the be the "behind string". The "fifth" string is simply called "fifth string". Both "second strings" are called "of the front" and "of the back", but only the "front third" and "front fourth" diverge from the "third behind" and fourth behind since these front strings are called, "small"

[20] Hillel ben David explains this phenomenon extensively in his *Significance of the Number Seven*, see [ben David].

[21] Mačák, K., "Caramuel Schrift *Mathesis Biceps, vetus et nova"*, p. 203-10; Schuppener, G., "Intellectus igitur, non reperit, sed facit Numeros" Caramuels Reflexionen über das Zahlensystem, p. 219-34; Sabaino, D., "Shaping a Musical Encyclopaedia: Caramuel's *Musica* and its sources", p. 235-56, in *Juan Caramuel Lobkowitz: The last Scholastic Polymath*, Petr Dvořak and Jacob Schmutz, eds. (in [Puteanus, 1643] – *De anagrammatismo, quae Cabalae pars est, diatriba* by Henrik van Put *(Erycius Puteanus)* – published by [Dvořák and Schmutz, 2008]).

[22] [Meeùs, p. Pl.16]. Here, I mention Meeùs only as reporter of the story.

[23] Here, my usage of the term "isosonic" excludes the idea that these intervals were strictly and infallibly equal to one another. Isosonism in the Ancient World and, or in "so-called" primitive, *i.e.* "ethnic" music would be a system where intervals were sufficiently roughly equal not to be considered built from intervals being half or double each other. It is my postulation that this form of isosonism came from man's unconscious. Although comparative archaeo-ethno musicology is ill advised for reasons that shall not be mentioned here, I contend that non-acculturalized African, or other societies would have had similar unconscious impulses in their production of music, making it academically defensible to undertake, under those conditions, such a comparative study.

[24] UET VII 74. In Gurney, O.R., Ur Excavation Texts, [Gurney, 1973, v. VII, Pl. XXXV, 74].

[25] While the Arabic has "nunations", that is the ending in "n" of declension cases, Old-Babylonian has "mimations" working on the same principle. However, "mimations" only appeared in the Old-Babylonian period.

[26] [Dumbrill, 2005, p. 47–69].

[27] Dumbrill, Richard., YBC 11381: « New Evidence for Neo-Babylonian Enneatonism in Music Theory », see [Dumbrill, s.d.].

[28] [Crickmore, 2009, p. 53–56], and IV, in the same volume, Hesiod's "races" and "political degeneration" in Plato, p. 56-57.

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and "thin or created by the god Ea", respectively. The philological details have little importance in our demonstration and therefore shall not be discussed any further.[29]

Graphically the series can be rendered as:

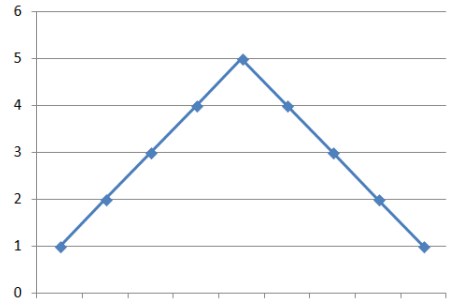

Fig. 5 Symmetric (palindromic-epicentric) numbering.

Fig. 6 Monumental enneachordal lyre from Karnak, *ca.* 1300 B.C.[30]

Which is much in keeping with the above illustration from the temple of the Aten in Karnak, since in this depiction, the central string being the shortest would also have been the highest in pitch. The other strings probably tuned symmetrically.

This order, with the lexical variations can be graphically represented as (estimated as we cannot precisely quantify the variations):

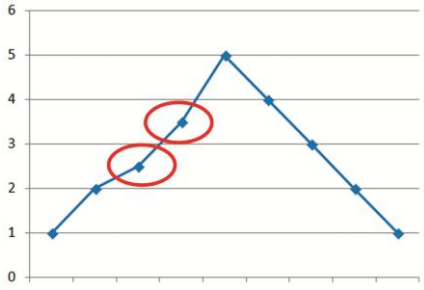

Fig. 7 Symmetric (palindromic/epicentric) numbering with lexical variations to strings 3 and 4 of the front.

[29] [Dumbrill, 2005, p. 27–36].

[30] [Manniche, 1991, p. 91, Pl. 54]

or with lexical variations to strings 3 and 4 of the front encircled in red,

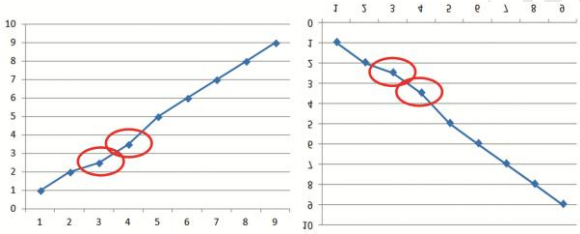

Fig. 8 Left ascending, and right descending.

and ascending, left, and descending, right, both with lexical variations encircled in red.

The symmetry (if we disregard the lexical variations of strings 3 and 4 of the front) would be in respect of the size of the intervals and not of their position[31].

This text would be a pre-numeracy symmetrical set. From what appears to be a central axis of symmetry, string 5, two 3/2 intervals would be projected towards the bass and towards the treble. Triads[32] would then be played in sequence through the whole set of strings to test the accuracy of the pitches, only by means of sonic memory, as is still practiced in much of the non-Western world (and in some cases in the West[33]). Then complementary pitches (infixes[34]) would be inserted

[31] [Dumbrill, 2005, p. 33].

[32] A triad is a series of three contiguous pitches of undefined polarity, dimension, intensity, tempo and rhythm.

[33] In piano factories, as soon as the instruments are strung, "chipping" takes place. This consists in tuning all the "a_s" (or "c_s", in the United Kingdom) by plucking each of the strings with an ivory (now plastic) plectrum, and then progress with the chipping by semitones up to the treble, and down to the bass. When the chipping is finished, the piano is almost in tune. This shows that tonal memory can be as accurate as to replicate the whole span of a piano in the equal temperament. Paul Milesi ([Milesi, s.d.]) writes: *"When a piano is significantly below standard concert pitch (A = 440Hz), the tone of the piano is dull and lackluster, and other instruments may have difficulty playing in tune with it. In this case, before we can successfully achieve a stable fine tuning, we must first do a rough tuning of every string so that each is very close to the pitch at which it will end up during the fine tuning. This gross pitch adjustment is called chip tuning [...]. Sometimes the entire piano must be chip tuned more than once to ensure stability of pitch for a good fine tuning."*

[34] Musical infixes, in my theories, are comparable to linguistic infixes. (A linguistic infix is an affix inserted inside a word stem (an existing word). It contrasts with *adfix*, a rare term for an affix attached to the end of a stem, such as a prefix or suffix.) In my theories, any additional pitch within an interval is an infix. A suprafix is a pitch contiguously added above the interval and an infrafix is contiguously added below the boundaries of the interval. This element of my theories comes from early Mesopotamian linguistics where languages, such as Sumerian and Akkadian were written syllabically with open or closed syllables on the patterns: c-v-c (consonant-vowel-consonant), or v-c-v, or c-c, and in which additional vowels were added should they be required to form grammatical constructions. It would therefore not be surprising that intervals, of the same linguistic periods would have followed the same rules, unlike in the West, much later, where and when intervals were and are considered as fundamentally empty even when they are

→

within the triads and tested in the same manner, to generate some form of approximately isosonic pitch set. Since it appears that isosonism is obscure to certain scholars, as I am informed, I will therefore briefly document its occurrences, its morphology and its tuning, with the Indonesian Gamela slendro and Pelog; Ugandian harp; south African Balafon, etc., in this endnote[35], as I feel it is inappropriate to include this *in texto*. The lexical variations would suggest "pitch bending" but we have to assume that prior to these variations, there was symmetry, or a certain notion of symmetry, which means that strings 3 and 4 of the front would have been the "sonic mirror" of strings 3 and 4 of the back. However, we cannot exclude the polyphonic hypothesis in which case the symmetry would have been metaphorical, or perhaps metonymic in which cases, the numbering, too would also be either metaphorical or metonymic[36].

Text CBS 10996 has taught us that there were only two intervals known in the initial and hypothetical 13 pitch set: fifths(?), and thirds(?). Although it would be absurd to suggest that these intervals were of just consonance, without formal evidence; but it would be equally absurd to rule out that they were not, and therefore we should satisfy ourselves with approximate isosonism.

However, I contend that as soon as arithmeticians got hold of sound, their metrology took over the whole of the system. They used the regular numbers[37] of sexagesimal arithmetics which happen to quantify, exactly, natural harmonics, to "domesticate" the original "pre-numeracy" pitch values which hitherto would not have agreed with their numbers.

It is impossible to understand how they would have discovered the relation of the regular numbers with quantifications of natural harmonics, but it remains certain that they did as is sufficiently documented in the mathematical texts from Nippur[38] and as far as from the land of Elam. Additionally, the highest gods of the pantheon were also given sexagesimal (not always) regular numbers, Anu was 60, Enlil, 50 and Ea 40. Thus the relationship of Anu to Ea was 60/40 = 3/2; Anu to Enlil = 60/50 = 6/5. These god numbers would tend to support my theory that only 3/2, 5/4 and 6/5 were initially the only known intervals as we find them in the 13 pitch set arrangement in CBS 10996. Later, other numbers came to complement the series and we find Ishtar with 15 and Bel Marduk with 14. 15/14 = 60/56 (119.4 cents); and Anu's second number and Shamash = 21/20 (84.5 cents).

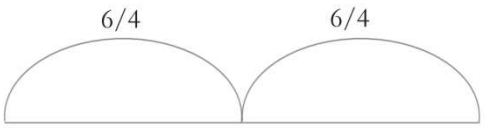

Fig. 9 Projection of two 3/2 from a common axis of symmetry. (6/4 = 3/2).

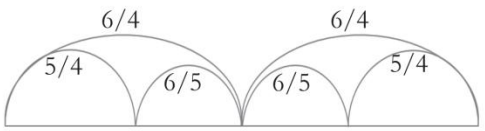

Fig. 10 Placement of 6:5 and 5:4 within 6/4 (=3/2).

Then complementary pitches would have been placed inside 5/4 and 6/5 probably with no other reference or method than some form of sonic memory.

→
called "octave". In the Orient, the contents of intervals vary and have various names, a tradition which stems from Ancient Mesopotamia, at least four thousand years ago and which survives nowadays under the form of "*ajnās*" or sets of the *maqām*.

[35] It will therefore not be surprising that comparable tuning methods are used in extra European tuning of various pitch sets requiring less accuracy than equal temperament tuning. Some argue that the equal temperament is isosonic. It is not, since the seven degrees of the heptatonic paradigm are not equal as it holds tones and semitones. Isosonism describes intervals of equal value and which are not necessarily confined to the octave. Furthermore, since isosonism describes the value of intervals and not the value of pitches, an isopentasonic system, for example, has six pitches and is not an isohexasonic system. Curt Sachs, in his *The wellsprings of Music* ([Sachs, 1962, p. 103]) mentions that "...there are many more ways of tuning [and in] Uganda, harps are [...] 'isotonic': one Ganda people divides the octave into five, in principle equal, steps of around 240 cents, which corresponds to the *saléndro* gender of Java's and Bali's *gamelan* orchestras."

[36] Metonymy works by the association between two concepts, whereas the term *metaphor* is based upon their analogous similarity. When people use metonymy, they do not typically wish to transfer qualities from one referent to another as they do with metaphor. Two examples using the term "fishing" help clarify the distinction. The phrase "to fish pearls" uses *metonymy*, drawing from "fishing" the idea of taking things from the ocean. What is carried across from "fishing fish" to "fishing pearls" is the domain of *metonymy*. In contrast, the metaphorical phrase "fishing for information" transfers the concept of fishing into a new domain. If someone is "fishing" for information, we do not imagine that the person is anywhere near the ocean; rather, we transpose elements of the action of fishing (waiting, hoping to catch something that cannot be seen, probing) into a new domain (a conversation). Thus, metaphor works by presenting a target set of meanings and using them to suggest a similarity between items, actions, or events in two domains, whereas metonymy calls up or references a specific domain (here, removing items from the sea) – see [Wikipedia Contributors, 2014a].

[37] Regular numbers are numbers which evenly divide powers of 60. As an example, $60^2 = 3600 = 48 \times 75$, so both 48 and 75 are divisors of a power of 60. Thus, they are regular numbers. Equivalently, they are the numbers whose only prime divisors are 2, 3, and 5. In the study of Babylonian mathematics, the divisors of powers of 60 are called regular numbers or regular sexagesimal numbers, and are of great importance due to the sexagesimal number system used by the Babylonians. In music theory, the just intonation of the so-called diatonic scale involves regular numbers.

[38] [Dumbrill].

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The mathematicians having "high-jacked" theory, it became obvious that they would have corrected the soundscape so that it fitted with their sexagesimal metrology. Thus a series of regular numbers found in mathematical text of the Temple library of Nippur[39] gives the following sequence:

(81) 80 72 64 60 54 48 45 40 36

[(81/80 = 21.5 c.)]; (80/72 = 182.4 c.); (72/64 = 203.9 c.)

(64/60 = 203.9 c.); (60/54 = 182.4 c.); (54/48 = 203.9 c.)

(48/45 = 111.7 c.); (45/40 = 203.9 c.); (40/36= 182.4 c.)[40].

While the construction suggested in our texts would imply that it should be:

81 72 64.8 60 54 48 45 40 36

This series of quantifications can be read either as string lengths or as frequencies. However, it would be impetuous to assume that the Sumero-Babylonians had understood the concept of frequency. But who knows? What is certain is that the figure of 64.8 is not a regular sexagesimal number: it is a number which in relation to its opposite generates a most dissonant interval, but there again, what was the perception of dissonance 4000 years ago? Another text already mentioned, UET VII, 74 (see note 21) uses the term *zaku* for consonance and *la zaku* for dissonance insofar as *zaku* means "clear" and "*la zaku*" unclear[41]. This dissonance would have been corrected by the sound of the next string, string 4, made by the god Ea, who corrected the dissonance. This is probably the reason for these two strings having textual variations added to them. Going back to 64.8, this therefore presents a problem and it is probably by readjusting 81 to 80 (being what would later be plagiarized as syntonic comma or comma of Didymus) that they solved the problem. The sequence thus would thus be reformed as:

80 72 64 60 54 48 45 40 36

The schematic tuning system is showed in Fig. 11.

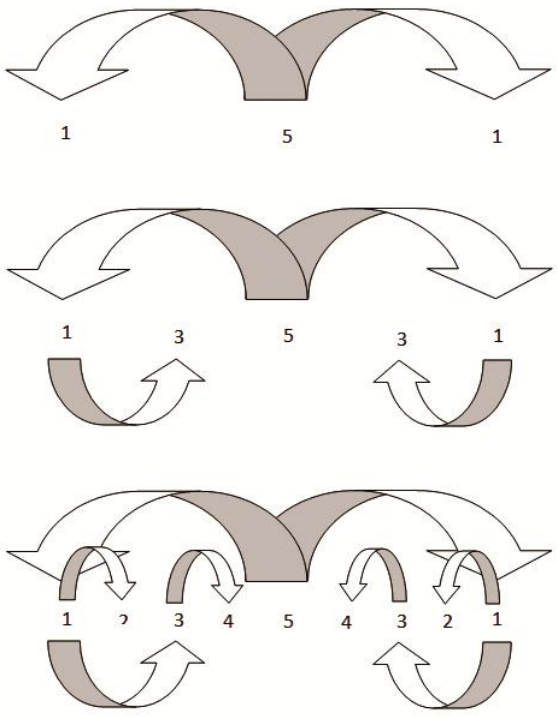

Fig. 11 Schematic rendition of the instructions in text UET VII, 126.

It is only the assumed association of the schematic rendition above which leads to an hypothetical equation with regular numbers which in this case would produce the following quantifications and ratios:

80		72		64		60		54		48		45		40		36
	10/9		9/8		16/15		10/9		9/8		16/15		9/8		10/9	
	182		204		112		182		204		112		204		182	

Table 1 The top row gives regular numbers; the middle row, ratios between regular numbers and bottom row cent values of ratios. (Can be read rising or falling and quantifications taken as either string lengths or frequencies.)

However, this only expresses the arithmetical interference applied to a system which otherwise and originally might have been significantly different from the above figures.

Now, it must be made clear that isosonism lists intervallic values not not pitch quantification and that therefore an isooctasonic set has nine degrees with eight intervals (see Table 2 and FHT 1[42]). This graphic shows that the isooctasonic set is made up of 8 equal intervals of 175.5 cents each which in equal temperament quantification would equate to 7 "equally tempered" quartertones each. This quantification is of course irrelevant to the period with which we are concerned and therefore is given only as a comparative means. It is

[39] [Hilprecht, 1906].; [Dumbrill, 2009a].

[40] With extended precision, these would amount to :
[(81/80 = 21.506290 cents)]; (80/72 = 182.403712 cents); (72/64 = 203.910002 cents)
(64/60 = 203.910002 cents); (60/54 = 182.403712 cents); (54/48 = 203.910002 cents)
(48/45 = 111.731285 cents); (45/40 = 203.910002 cents); (40/36= 182.403712 cents).

[41] [Dumbrill, 2005, p. 48–51].

[42] For « Figure Hors Texte ».

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interesting to note that isooctasonism generates a "natural anhemitonic hexasonic set" made up for degrees 1; 2; 4; 5; 6; 8 and 9, that many would qualify as "anhemitonic pentatonic" if it were restricted to the octave (see FHT 2 and FHT 3).

1	1/1	0.0	unison
2		175.500	
3		351.000	Meshaqah's 7 'quartertones' ('Neutral third')
4		526.500	
5	3/2	701.000	3/2 Just fifth
6		876.500	
7		1051.000	Meshaqah's 21 'quartertones'
8		1226.000	
9	9/4	1404.000	Double conjunct just fifths

Table 2 Isooctasonism within the span of two conjunct 3/2 intervals. These are pitch and not intervallic quantifications. (Can be read as it stands or in its reciprocal status.)

My point in this paper has been an attempt at demonstrating that isosonic sets would have preceded heterosonic systems which came as a consequence of numeracy. There is no reason for a primitive or an ancient system to include intervals, half, or about half the size of others. This phenomenon only appeared with arithmetical divisions and geometrical constructions but certainly not in their absence.

Once isosonic sets were subjected to arithmetical/geometrical domestication, much was lost, but also much was gained as this marked the dawn of musical theory, a phenomenon which took place in Mesopotamia soon after the rise of numeracy and literacy, that is around 3200 B.C., and which in the course of its long and slow evolution was to shape most of our Oriental and Occidental soundscapes.

CONCLUSION

In his *The Wellsprings of Music*[43] Curt Sachs wrote:

"Reading oriental music from western staff lines is just as deceptive as reading oriental poetry in a twenty-six letter transliteration without array of 'diacritical' dashes, tildes, dots and hooks. The staff lines and spaces entice the reader into a fatal misconception. The notes, let us say, of a Siamese melody, which has neither whole nor semitones, have no proper place anywhere on the staff. Forced upon and between the five lines, they deceive the reader with perfect fourths, thirds major and minor, and seconds major and minor where there are no such steps at all. They also deceive the reader by suggesting, in the conflict between the familiar lines we see and the unfamiliar steps we hear, that the exotic melodies in question are out of tune, in other words, that the West is right and the East is wrong...

...In describing non-western music, be it oriental or primitive, one must strictly refrain from misusing incongruous concepts of western music. The terminology that has been learned in music schools applies to a harmonic structure of music and is inappropriate, indeed misleading and distorting in descriptions of non-harmonic, non-western music."

[43] [Sachs, 1962, p. 28–29, 49].

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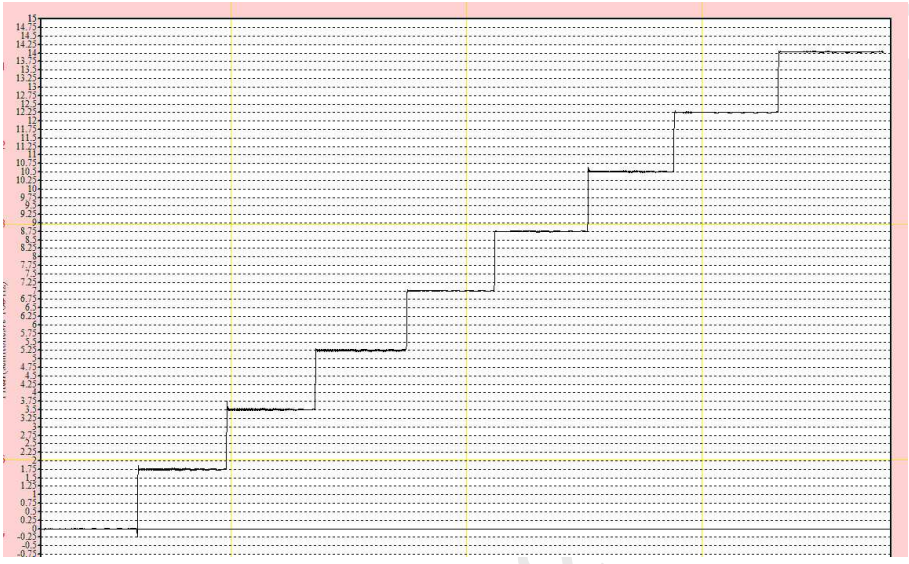
PLATES



FHT 1 Author's graphic representation of an isooctasonic pitch set. (can be read either rising or falling polarity). Vertical left: 1 = equal temperament semitone, 0.5 - equal temperament quartertone; 0.5 = equal temperament eighth of a tone.

FHT 2 Author's graphic representation of the hypothetical Babylonian heterooctasonic pitch set. (can be read either in rising polarity [left] as it stands, or in its reciprocal status [right]).

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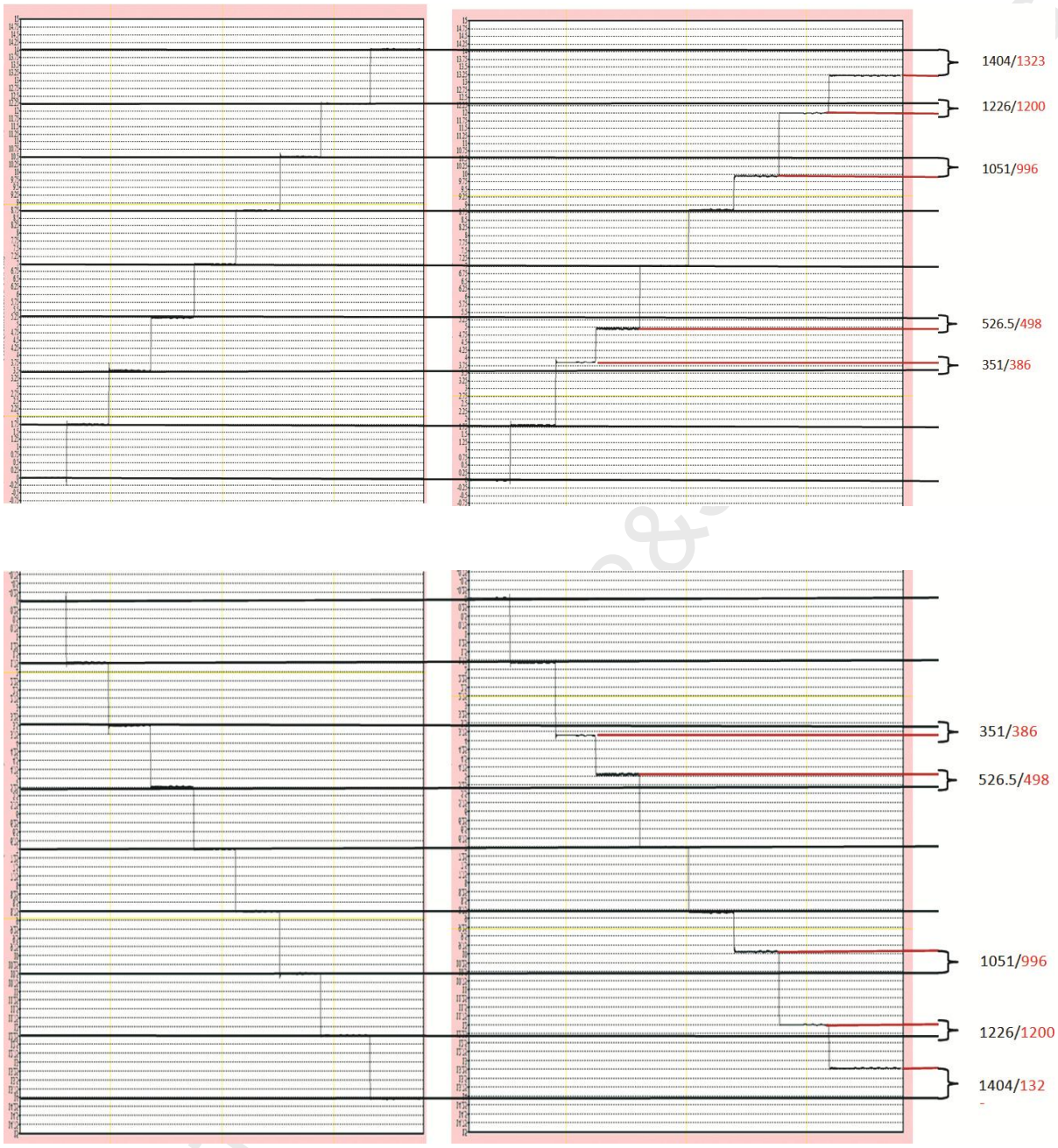

FHT 3 Author's comparative graphic representation. Left, isooctasonic set; right heterooctasonic set. The red lines indicate the divergences of the heterosonic from the isosonic set. (can be read as it stands [top] or in its reciprocal status [below]).

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